

REMARKS

Claims 1-10 are pending. By this Response, claims 9 and 10 are amended. Reconsideration and allowance based on the above amendment and following remarks are respectfully requested.

The Office Action rejects claims 1, 5 and 8 under 35 U.S.C. §102(b) as being anticipated by Hamada (US 5,453,876); claim 2 under 35 U.S.C. §103(a) as being unpatentable over Hamada in view of Lijima, et al. (US 6,782,610); claim 3 under 35 U.S.C. §103(a) as being unpatentable over Hamada in view of Vandamme, et al. (US 6,200,908); claim 4 under 35 U.S.C. §103(a) as being unpatentable over Hamada in view of Wheatley, et al. (US 5,122,905); claim 6 under 35 U.S.C. §103(a) as being unpatentable over Hamada in view of Fjelstad (6,583,444); claim 7 under 35 U.S.C. §103(a) as being unpatentable over Hamada in view of Tamaki (US 5,523,174); claim 9 under 35 U.S.C. §103(a) as being unpatentable over Malinovich, et al. (US 6,168,965) in view of Vandamme; and claim 10 under 35 U.S.C. §103(a) as being unpatentable over Malinovich, et al. in view of Fjelstad. These rejections are respectfully traversed.

Claim 1

The Office Action alleges that Hamada teaches each and every feature of claim 1. Applicant respectfully disagrees.

Hamada teaches a microlens array. The microlens array is formed by disposing a light condensing layer 33 on an upper surface of a substrate 31. A shading layer 32 is formed on the bottom of the substrate. The shading layer covers most of the area of the bottom of the substrate

except for areas where light is desired to pass, thus allowing formation of the microlens. When light passes through the areas not shaded by the shading layer, it causes the light condensing layer 33 to swell only in the areas which receive light. The swelling forms the convex lenses that make-up the microlens array. See column 5, lines 64 through column 6, lines 46.

Applicant respectfully submits that Hamada does not teach “a semiconductor substrate having a front surface and rear surface, a photoelectric converting portion being formed on the front surface; a light shading means for shading an incoming light from the rear surface of the semiconductor substrate to said photoelectric converting portion, wherein said light shading means is formed at an area corresponding to at least the photoelectric converting portion, said area being on the rear surface of the semiconductor substrate, as recited in claim 1.

As recited in claim 1, the photoelectric converting portion is formed on the front surface of the substrate. Hamada teaches forming a light condensing layer on the front surface in order to create a lens. Further, the light shading means of claim 1 is used to shade light from the photoelectric converting portion. Specifically, the light reflected from the rear surface is prevented from being incident on the photoelectric converting portion even when the semiconductor substrate is thin, since the light shading means is formed on the rear surface of the semiconductor substrate. Hamada, to the contrary, teaches a shading means to define areas that allow light to pass in order to create microlenses. Finally, in accordance with claim 1, the light shading means is formed in an area corresponding to the photoelectric converting portions. Hamada, however, to the contrary, teaches forming shading means that correspond to a light condensing layer and not to a photoelectric converting portion. In fact, as shown in Fig. 5 of

Hamada, a liquid crystal display panel 51 is arranged between the microlens arrays 50. The microlens array does not have an active element such as a photoelectric converting portion.

The Office Action alleges that the teachings at column 1, lines 23-29 provide the claimed photoelectric converting portion. First, this teaching merely teaches that the micro array of Hamada can be used to condense light onto photoelectric conversion regions. It does not teach forming a photoelectric converting portion on a front surface of a substrate. Second, this section of Hamada teaches supplying light to photoelectric conversion regions. Claim 1 provides a light shading means to suppress light from the rear surface of the substrate reaching the photoelectric converting portions. Finally, if light is reaching the photoelectric converting regions in Hamada through the microlenses, then the light shading means cannot be formed in an area corresponding to the photoelectric converting regions.

Thus, Hamada fails to teach each and every feature of independent claim 1 as required. Further, Lijima, Vandamme, Wheatley, Fjelstad and Tamaki fail to make up for Hamada's deficiencies.

Claim 9

Regarding claim 9, the Office Action alleges that Malinovich teaches each of the claimed features except for use of a grinding step as recited in independent claim 9. The Office action alleges that Vandamme provides this feature absent in Malinovich and the combination would teach the features of independent claim 9. Applicant respectfully disagrees.

Malinovich teaches a method for producing a back illuminated CMOS image sensor. The sensor is mounted on a substrate and a second surface 320 is thinned by an erosion process in order to allow light through such that the pixels fabricated on the substrate can be exposed by the light. The back illuminated sensor forms a photoelectric converting portion on the processing surface of the wafer, and outputs the incident light from the rear surface as image information, by grinding the rear surface thin to the level where the silicone allows the light to enter. Accordingly, fluctuation (non-flatness) on the rear surface directly deteriorates the image. Therefore, the grinding process in Malinovich requires flatness and smoothness at a high precision level. See column 6, lines 44-67. Thus, Malinovich teaches thinning a surface in order to allow light to enter through that surface. This is entirely different from the grinding process in the present invention.

Vandamme teaches a process for reducing the waviness of a semiconductor wafer. This process can include a grinding technique which removes the waviness thus creating a smooth surface. The technique further includes polishing the wafer to create a smooth surface. This process is performed on the front surface of the wafer. See column 3, lines 42 through 52. The grinding step taught in Vandamme is not used to create a rough surface as suggested in the Office Action. Thus, the combination of Malinovich and Vandamme fail to teach or suggest, a grinding step for forming a rough surface on the rear surface of the semiconductor substrate to reflect light away from the rear surface, as recited in claim 9.

Further, applicant notes one of ordinary skill in the art would not be motivated to use the grinding step in Vandamme instead of the erosion process taught in Malinovich to thin a surface

thereof. Vandamme teaches a grinding process for only the front surface of the wafer. Malinovich teaches a backside illuminated image sensor. Thus, one of ordinary skill in the art would not have looked to the grinding step of Vandamme that employs front surface grinding to the teachings of Malinovich that require precise rear surface grinding.

Furthermore, even if one of ordinary skill in the art would be motivated to use Vandamme's grinding process with Malinovich's teachings, which applicants contend they would not, Malinovich teaches that the grinding step is used in order to thin the surface in order to allow light to enter through the surface so that the light reaches pixels fabricated on the substrate. Thus, replacing Malinovich's erosion process with Vandamme's grinding step would only replace the method for creating the thinned surface that allows light to be transmitted through the surface.

Neither Malinovich nor Vandamme teach or suggest a grinding step to form a rough surface on the rear surface of semiconductor substrate so that light is reflected away from the rear surface of the semiconductor substrate as provided in the embodiments of independent claim 9.

Therefore, in view of the above, a combination of Malinovich and Vandamme fail to teach each and every feature of independent claim 9 as required.

Claim 10

Regarding claim 10, Fjelstad teaches using the encapsulate to encase conductive pads 28. The encapsulate is positioned between a lower surface of a lid 54 and upper surface of a

sacrificial layer 20. Fjelstad does not teach or suggest bonding a wiring board on the rear surface of said semiconductor substrate using light shading adhesive the light shading adhesive being provided between the wiring board and the semiconductor substrate and suppressing light reflected from the rear surface of the semiconductor substrate from reaching the semiconductor device, as recited in claim 10. The adhesive in Fjelstad is not provided between the wiring board and the semiconductor substrate.

Further, Malinovich fails to remedy Fjelstad's deficiencies. Malinovich teaches an adhesive 420 that attaches a wafer 300 to the substrate 410. Nowhere does Malinovich teach or suggest using an adhesive, let alone a light shading adhesive, to bond a wiring board to the rear surface of a semiconductor substrate where the adhesive is positioned between the top surface of the wiring board and the rear surface of the semiconductor substrate, as recited in claim 10.

Therefore, in view of the above, applicant respectfully submits that the combination of Fjelstad and Malinovich fail to teach each and every feature of independent claim 10 as required.

Conclusion

In view of the above, applicant respectfully requests reconsideration and withdrawal of the above noted rejections. Applicant respectfully submits that the application is now in condition for allowance. Favorable consideration and prompt allowance are earnestly solicited.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Chad J. Billings (Reg. No. 48,917) at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

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Respectfully submitted,

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